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Analysis of Restaurant Ordering Patterns Using Apriori Algorithm

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ABSTRACT

This study implements the Apriori algorithm to analyze ordering patterns in home-based restaurants, specifically Dapur Mb Yani. Sales transaction data for three weeks shows that the Geprek Sambal Merah, Geprek Sambal Ijo, and Ayam Crispy menus are the most frequently ordered items, both individually and in combination. The combination of Geprek Sambal Merah, Ayam Crispy, and Es Teh has a high association value, making it a candidate for bundling promotions, while the strong relationship between Geprek Sambal Merah and Geprek Sambal Ijo opens up opportunities for special offers involving both menus. These results help restaurant managers design more effective promotional strategies, manage ingredient stocks efficiently, and improve customer experience. The application of the Apriori algorithm proves its relevance in supporting data-based decisions, especially for small businesses, as well as opening up opportunities for further development in the culinary industry.

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1. INTRODUCTION

In the digital era, information technology has developed rapidly and has had a significant impact on various sectors, including the food and beverage industry [1]. One of the important technologies in analyzing data is data mining, which is the process of finding patterns or hidden information from large data sets [2][3]. In the context of home restaurants, data mining can be an effective tool to help decision making, such as identifying customer ordering patterns, determining the most popular menus, and developing more effective promotional strategies [4]. However, many home restaurants have not fully utilized the potential of their data. The majority of small businesses still use manual or traditional methods to record and analyze data, which are often inefficient and provide less strategic insight [5]. This results in opportunities to improve operational efficiency and profits not being optimized.

The Apriori algorithm, as one of the data mining methods, is known to be effective in finding association patterns in transaction data [6][7]. This algorithm has been widely applied in the retail and e-commerce industries to reveal relationships between products that are often purchased together [8][9]. However, the application of this algorithm to home restaurants is still rare, thus opening up opportunities for further research that focuses on small businesses with limited resources [10][11]. This study aims to implement the Apriori algorithm in analyzing ordering patterns in home restaurants. With this analysis, restaurant managers can develop more targeted business strategies, such as determining menu combinations that are in demand by customers, managing ingredient stocks, and designing

targeted promotions [12][13]. In addition to providing academic contributions, this study is expected to provide practical solutions that are useful for restaurant managers in increasing their competitiveness in a competitive market [14]. With this background, this study has important relevance to answering the challenges of data management in home restaurants and opening up the potential for wider application of data mining technology in the small and medium business sector [15].

2. METHOD

This study uses a quantitative approach with a transactional data analysis method to identify purchasing patterns at Dapur Mb Yani using the Apriori Algorithm. The data used is sales data for three weeks which includes information on items sold in each transaction. The analysis process is carried out through several main steps, namely data processing, itemset formation, support and confidence calculations, to interpretation of association rules. Minimum support is set at 30% and minimum confidence at 70% to filter relevant association rules [16].
The analysis process uses the main formula of the Apriori Algorithm as follows:
1. Support
Support measures how often a combination of items (itemsets) appears in a transaction dataset, with the formula:

$$Support\ (A) = \frac{Number\ of\ Transactions\ Containing\ X}{Total\ Number\ of\ Transactions} \times 100\ \%$$

This value is used to filter itemsets that have high frequency based on the minimum support that has been determined.

2. Confidence
Confidence calculates the probability of item B being purchased when item A has been purchased, with the formula

$$Confidence = (A \rightarrow B) = \frac{Support(A \cup B)}{Support\ A} \times 100\ \%$$

Confidence is used to assess the strength of the relationship between items in an association rule.

3. Lift
Lift evaluates the strength of the relationship between items A and B by comparing the joint probability of both to the probability of each item independently:

$$Lift\ (A \rightarrow B) = \frac{Confidence(A \rightarrow B)}{Support(B)} \times 100\ \%$$

A Lift value greater than 1 indicates that the relationship between items is stronger than would be expected randomly.

Research Stages:

1. Data Collection
The author collected data through two sources:
Primary Data: Obtained from direct interviews with sources who provided information about sales patterns and featured menus.
Secondary Data: Obtained from manual sales books and online sales applications that recorded transactions for the last three months.
2. Data Preprocessing
Data was prepared by removing duplication and tidying up the format. Transactions were converted into tabular with binary representation (1 for sold items, 0 for unsold items).
3. Initial Itemset Formation
Items from transactions were grouped into 1-itemsets based on frequency. These itemsets were filtered using a minimum support of 30%.
4. Itemset Formation Iteration
Itemsets that passed were used to form new combinations (2-itemsets, 3-itemsets, etc.). Support was calculated to filter combinations that met the minimum support.

5. Confidence and Lift Calculation
Association rules were formed from itemsets that passed. Confidence was calculated to assess the probability of relationships between items, while lift was used to measure the strength of the relationship.

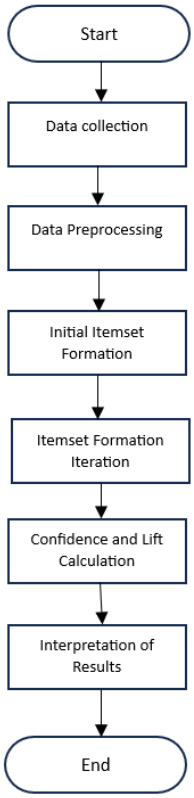

Figure 1. Research Methods

6. Interpretation of Results
Association rules that meet a minimum confidence of 70% and lift >1 are analyzed to find significant purchasing patterns.

3. RESULTS AND DISCUSSION

The dataset used in this study includes menu sales transaction data at Dapur Mb Yani for a period of three consecutive months, namely March, April, and May. Each transaction records a list of menus purchased by customers, which provides insight into purchasing patterns and consumer preferences for various menus. This data provides an important picture of customer consumption habits and how certain menus are related to each other in a single transaction. By analyzing the transaction data, we can identify menus that are frequently purchased together, which can then be used to build association rules. The purpose of this analysis is to gain a deeper understanding of consumer purchasing patterns and provide a basis for planning more effective marketing strategies. The following is a transaction table that illustrates the menu sales data that will be analyzed further, which can be seen in Table 1.

Table 1. Sales data for week 1

No	Menu Name	Number of transactions
1	Ayam Geprek S Merah	52
2	Ayam Crispy	41
3	Es Teh	39
4	Jus Jeruk	27
5	Jus Jambu	19
6	Ayam Geprek S Ijo	49

7	Lemon Tea	29
8	Jus Mangga	21

Table 1 shows the sales data of food and beverage menus at Dapur Mb Yani for one week. From the data, Ayam Geprek Sambal Merah is the menu with the highest number of sales, which is 52 portions. Ayam Geprek Sambal Ijo is in second place with sales of 49 portions, followed by Ayam Crispy which sold 41 portions. Other menus such as Iced Tea, Lemon Tea, and various juices have lower sales, indicating the potential for developing strategies to increase the appeal of these menus.

Table 2. Sales data for week 2

No	Menu Name	Number of transactions
1	Ayam Geprek S Merah	43
2	Ayam Crispy	49
3	Es Teh	31
4	Jus Jeruk	29
5	Jus Jambu	19
6	Ayam Geprek S Ijo	61
7	Lemon Tea	33
8	Jus Mangga	24

In Table 2, Ayam Geprek Sambal Ijo is now recorded as the menu with the highest number of sales in week 2, with a total of 61 sales. In second place, Ayam Geprek Sambal Merah sold 49, and Ayam Crispy is in third place with 43 sales.

Table 3. Sales data for week 3

No	Menu Name	Number of transactions
1	Ayam Geprek S Merah	54
2	Ayam Crispy	43
3	Es Teh	34
4	Jus Jeruk	27
5	Jus Jambu	22
6	Ayam Geprek S Ijo	59
7	Lemon Tea	28
8	Jus Mangga	20

In Table 3, Ayam Geprek Sambal Ijo is still recorded as the most sold menu in week 3 with a total of 59 sales. Ayam Geprek Sambal Merah is in second place with a total of 54 sales, while Ayam Crispy is in third place with 43 sales. The accumulation of Dapur Mb Yani transactions from sales in the last 3 weeks is taken from the most sold items each month.

Table 4. Mb Yani Kitchen Sales Transaction Data

transaction number	Purchase Items
1	Ayam Geprek S Merah, Ayam Crispy, Es Teh
2	Ayam Geprek S Merah, Ayam Crispy, Lemon Tea
3	Ayam Crispy, Ayam Geprek S Merah, Ayam Geprek S Ijo
4	Ayam Geprek S Ijo, Ayam Crispy, Es Tea
5	Ayam Geprek S Ijo, Ayam Crispy, Lemon Tea
6	Ayam Geprek S Merah, Jus Jambu, Es Teh
7	Ayam Geprek S Merah, Jus Mangga, Lrmon Tea
8	Ayam Geprek S Ijo, Jus Jeruk, Lemon Tea
9	Ayam Geprek S Ijo, Jus Jeruk, Es Teh
10	Ayam Geprek S Ijo, Jus Mangga, Es Teh
11	Ayam Geprek S Merah, Ayam Geprek S Ijo, Jus Jeruk

12	Ayam Geprek S Merah, Ayam Geprek S Ijo, Ayam Crispy

Weekly sales transaction data can be presented in a neatly structured table format, providing clearer and more organized information. Presenting data in tabular format makes it easier to analyze purchasing patterns, identify sales frequencies, and manage data more efficiently. The following table illustrates the tabular format for the transaction data:

Table 5. Transaction Data Tabular

Transaksi	Geprek S Merah	Ayam Crispy	Es Teh	Jus Jeruk	Jus Jambu	Geprek S Ijo	Lemon Tea	Jus Mangga
1	1	1	1	0	0	0	0	0
2	1	1	0	0	0	0	1	0
3	1	1	0	0	0	1	0	0
4	0	1	1	0	0	1	0	0
5	0	1	0	0	0	1	1	0
6	1	0	1	0	1	0	0	0
7	1	0	0	0	0	0	1	1
8	0	0	0	1	0	0	1	0
9	0	0	1	1	0	1	0	0
10	0	0	1	0	0	1	0	1
11	1	0	0	1	0	1	0	0
12	1	1	0	0	0	1	0	0

Based on the prepared tabular format table, the next step is to form 1 itemset using a minimum support limit of 30%. The following is a calculation table used to form 1 itemset:

Table 6. Frequent 1-Itemsets

No.	Item	Frequent	Support (%)
1	Geprek S Merah	7	58.33
2	Ayam Crispy	7	58.33
3	Es Teh	6	50.00
4	Geprek S Ijo	8	66.67
5	Lemon Tea	5	41.67
6	Jus Jeruk	6	50.00
7	Jus Mangga	5	41.67

The next step is the formation of itemset 2. At this stage, two items from itemset 1 that meet the minimum support criteria of 30% are combined. Each pair of items formed is then calculated for the frequency of occurrence in the transaction data. The following table shows the calculation results for itemset 2:

Table 7. Frequent 2-Itemsets

No.	Itemset	Frequent	Support (%)
1	{Geprek S Merah, Ayam Crispy}	5	41.67
2	{Geprek S Merah, Es Teh}	5	41.67
3	{Geprek S Merah, Jus Jeruk}	4	33.33
4	{Geprek S Merah, Geprek S Ijo}	6	50.00
5	{Ayam Crispy, Es Teh}	5	41.67
6	{Ayam Crispy, Geprek S Ijo}	5	41.67
7	{Es Teh, Geprek S Ijo}	5	41.67
8	{Lemon Tea, Geprek S Ijo}	4	33.33
9	{Jus Jeruk, Geprek S Ijo}	4	33.33
10	{Jus Mangga, Geprek S Ijo}	4	33.33

After obtaining 2 itemsets with a minimum support value above 30%, the next step is to form 3 itemsets with a minimum support limit of 30%. The following is a table showing the calculation for the formation of the 3 itemsets:

Table 8. Frequent 3-Itemsets

No.	Itemset	Frequent	Support (%)
1	{Geprek S Merah, Ayam Crispy, Es Teh}	4	33.33
2	{Geprek S Merah, Ayam Crispy, Geprek S Ijo}	4	33.33
3	{Geprek S Merah, Es Teh, Geprek S Ijo}	4	33.33
4	{Ayam Crispy, Es Teh, Geprek S Ijo}	4	33.33

The next step is to calculate the confidence with a minimum value of 70%. This process aims to evaluate the strength of the relationship between items in the association rule, where the higher the confidence value, the stronger the relationship. Rules that have confidence equal to or greater than the specified minimum value will be considered valid association rules. Here is the calculation table for minimum confidence:

Table 9. Confidence and Lift Calculation Results

No.	Itemset	Frequent	Frequent A	Frequent B	Confidence (A → B)	Confidence (B → A)	Lift (A → B)	Lift (B → A)	Status
1	{Geprek S Merah} → {Ayam Crispy}	5	7	7	71.43	71.43	1.22	1.22	Passed
2	{Ayam Crispy} → {Geprek S Merah}	5	7	7	71.43	71.43	1.22	1.22	Passed
3	{Geprek S Merah} → {Es Teh}	5	7	6	71.43	83.33	1.43	1.19	Passed
4	{Es Teh} → {Geprek S Merah}	5	6	7	83.33	71.43	1.19	1.43	Passed
5	{Ayam Crispy} → {Es Teh}	5	7	6	71.43	83.33	1.43	1.19	Passed
6	{Es Teh} → {Ayam Crispy}	5	6	7	83.33	71.43	1.19	1.43	Passed
7	{Geprek S Ijo} → {Geprek S Merah}	6	8	7	75.00	85.71	1.29	1.29	Passed
8	{Geprek S Merah} → {Geprek S Ijo}	6	7	8	85.71	75.00	1.43	1.43	Passed
9	{Geprek S Ijo} → {Ayam Crispy}	5	8	7	62.50	71.43	1.07	1.07	Not Passed

10	{Ayam Crispy} → {Geprek S Ijo}	5	7	8	71.43	62.50	1.19	1.19	Passed

Association Rules

Association rules help identify relationships between items in a transaction, with a minimum confidence of 70%. The analysis results show that several rules have high confidence, such as {Geprek Sambal Merah} → {Ayam Crispy} with a confidence of 71.43%, which means there is a 71.43% probability that customers who buy Geprek Sambal Merah will also buy Ayam Crispy. In addition, {Iced Tea} → {Geprek Sambal Merah} has a confidence of 83.33%, indicating a strong relationship between the purchase of these two items, while {Geprek Sambal Merah} → {Geprek Sambal Ijo} has a confidence of 85.71%, indicating that customers tend to buy both menu variants together. However, there are rules with low confidence, such as {Geprek Sambal Ijo} → {Ayam Crispy} which only has a confidence of 62.50%, so it does not meet the minimum confidence criteria that have been set.

Interpretation and Recommendations

The results of the Apriori analysis show an interesting pattern that can support Dapur Mb Yani's marketing strategy. The Geprek Sambal Ijo, Geprek Sambal Merah, and Ayam Crispy menus are the most frequently purchased, both individually and in combination, so promotions can be focused on these menus, for example through discounts or bundling. The popular combination of Geprek Sambal Merah, Ayam Crispy, and Iced Tea can be used as a savings package to attract more customers. The strong relationship between Geprek Sambal Merah and Geprek Sambal Ijo shows opportunities for additional promotions, such as the offer of "buy two geprek variants, get a free drink". In addition, drinks such as Iced Tea and Lemon Tea which are often purchased with main meals can be used as part of a promotional package to increase sales.

4. CONCLUSION

This study successfully implemented the Apriori algorithm to analyze ordering patterns in home-based restaurants, especially Dapur Mb Yani. The results of the analysis show that this algorithm is effective in identifying relationships between items in transactions, such as food and beverage menus that are often purchased together. The main findings include the Geprek Sambal Merah, Geprek Sambal Ijo, and Ayam Crispy menus which are the most frequently ordered items, both individually and in combination, with consistent purchasing patterns throughout the analysis period. The combination of Geprek Sambal Merah, Ayam Crispy, and Es Teh has a high association value, making it an ideal candidate for promotional strategies such as bundling packages. In addition, the strong relationship between the Geprek Sambal Merah and Geprek Sambal Ijo menus shows great potential for cross-promotion strategies. Based on these findings, restaurant managers can optimize business strategies through more effective promotion planning, more efficient stock management, and improved customer experience. The application of the Apriori algorithm in this study proves its relevance in supporting data-based decision making, especially for small businesses with limited resources. This research also opens up opportunities for further development, such as the application of other more complex algorithms, the use of larger datasets, or integration with customer management systems for more comprehensive analysis.

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